Parasitoid flies (Diptera, Tachinidae) in true crickets (Orthoptera, Grylloidea): New host records from Brazil, identification key to parasitoids, and revision of host-parasitoid interactions

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Abstract

True crickets (Orthoptera, Grylloidea) are often parasitized by tachinid flies (Diptera, Tachinidae). However, the diversity of these parasitoids and their oviposition strategies remain unclear. Although some flies are specialized in locating crickets by their calling songs, such as the phonotactic fly *Ormia ochracea* (Bigot, 1889), a large portion of the tachinids that attack true crickets show different host search strategies and are adapted to parasitize other orthopteroid insects as well. However, these parasitoids have a complex and challenging taxonomy that precludes further improvement in the understanding of Tachinidae-Orthoptera interactions. Here, we described and illustrated seven new host records in Gryllidae and Phalangopsidae species from Brazil, including notes on the diagnostic characters of each parasitoid and host. An illustrated identification key to Tachinidae genera recorded in Grylloidea is also provided. Finally, all published records of Tachinidae parasitism in true crickets were revised and are presented in an annotated catalog in order to understand the host range and different oviposition strategies of each parasitoid lineage.

Keywords

chirping, endoparasitoids, Gryllidae, Neotropical Region, oviposition strategy, Phalangopsidae, phonotactics

Introduction

The cricket clade (Ensifera, Grylloidea) is one of the most diverse in Orthoptera, with more than 6,000 species distributed worldwide (Cigliano et al. 2023). These orthopterans are a subject of interest to the scientific community and have been commonly used as models in studies, including in those on biogeography (e.g., Vicente et al. 2017, Campos et al. 2021), bioacoustics (e.g., Huber et al. 1989, Hershberger 2021, Zefa et al. 2022), behavior (e.g., Ono et al. 2004, ter Hofstede et al. 2015, Lobregat et al. 2019), and speciation (e.g., Otte and Alexander 1983, Otte 1994, Shaw 1996, 2002, Ritchie and Garcia 2005). The most common parasitoids of true crickets are horsehair worms (Nematomorpha) (Hanelt et al. 2005), parasitic wasps (Hymenoptera, Chalcidoidea) (Noyes 2019), and tachinid flies (Diptera, Tachinidae) (Stireman et al. 2021).

The Tachinidae are well known as endoparasitoids of several groups of insects and other arthropods, showing a great variety of oviposition strategies (Stireman et al. 2021). Gravid females exhibit either direct oviposition, where they lay eggs on or within the host, or indirect oviposition, where they place eggs near the host (Nakamura et al. 2013). Direct oviposition consists of laying incubated or unincubated eggs on the host's cuticle or injecting them into the host itself. Indirect oviposition strategies include laying incubated micro-type eggs on the host's food, which are subsequently ingested by the host, as well as by depositing incubated membranous eggs with well-developed first-instar larvae that either wait or actively search for the host. Species of Coleoptera, Hemiptera, Hymenoptera, and Lepidoptera are frequently recorded as hosts of tachinids; however, some tachinid flies are specialized parasitoids of orthopteroid insects (Guimarães 1977, Arnaud 1978, Tschorsnig 2017).

In Orthoptera, the majority of tachinid parasitism records involve Acridoidea and Tettigonioidea (Crosskey 1973, 1976, 1984, Guimarães 1977, Arnaud 1978, Tschorsnig 2017), while such records are scarce in Grylloidea. Despite this, one of the most studied cases of parasitism in Tachinidae involves a specialized parasitoid of field crickets, the phonotactic fly *Ormia ochracea* (Bigot, 1889) (e.g., Gray et al. 2019). Ormiini flies are distributed worldwide and are parasitoids of Ensifera, locating their hosts by eavesdropping on the calling songs of males using well-developed tympanal organs in the prothorax (Lehmann 2003, Nihei 2015, Gudin and Nihei 2019). The prevalence and impact of *O. ochracea* parasitism

have been reported as an important selective pressure in some populations of field crickets (Zuk et al. 2006), even shaping the density and distribution of different morphs in the population. However, only a few species of *Ormia* Robineau-Desvoidy, 1830, parasitize true crickets (Lehmann 2003).

Tachinidae species belonging to the New World genera *Anisia* Wulp, 1890, *Calodexia* Wulp, 1891, and *Exoristoides* Coquillett, 1897, are parasitoids of different orthopteroid insects, including a few records in true crickets (Rettenmeyer 1961b, O'Hara 2002, Weissman and Gray 2019). However, most of these species, especially in the Neotropical region, present a complex taxonomy, making it difficult to identify them accurately. This hinders the publication of host records and the expansion of our understanding regarding their host range.

Here, we present seven new host records for *Anisia*, *Calodexia*, and *Ormia* species reared from different species of Gryllidae and Phalangopsidae in Brazil. In addition, we provide an illustrated identification key to Tachinidae genera recorded in Grylloidea and a revision of grylloid hosts of Tachinidae in an annotated host catalog that includes an overview of the host use and oviposition strategies of their respective parasitoids.

Methods

The cricket specimens used in this study were originally collected from several localities in Brazil from 1989 to 1991 (except *Anurogryllus* (*Urogryllus*) *toledopizai* de Mello, 1988; see record and catalog below) and then kept in the laboratory to document further observations regarding their behavior. Meanwhile, tachinid flies emerged from them. Tachinidae and Grylloidea specimens were deposited in the collections of the Museu de Zoologia da Universidade de São Paulo (MZSP), São Paulo, state of São Paulo, Brazil, and of the Laboratório de Insetos do Departamento de Biodiversidade e Bioestatística, Setor de Zoologia, Universidade Estadual Paulista "Júlio de Mesquita Filho" (BOTU), Botucatu, state of São Paulo, Brazil, respectively. When revising the host records, we found little information regarding the sex and number of parasitized crickets preserved in the BOTU collection (see records and catalog below). We identified the crickets using the taxonomic studies of de Mello (1992), Souza-Dias et al. (2015), Campos et al. (2017), and Redü and Zefa (2017). Photographs of crickets were taken using a Canon camera with a 100-mm macro lens. Serial photographs of different focuses were stacked using Helicon Focus v. 8.2.2. With the exception of *Guabamima lordelloi* de Mello, 1993, the photographed specimens are not those parasitized. When possible, we used images of specimens of the same species to illustrate the taxa, as the parasitized specimens were very damaged.

We identified the tachinids using keys to the New World genera of Blondeliini (Wood 1985) and the Central American genera of Tachinidae (Wood and Zumbado 2010). *Calodexia* species were identified using the keys proposed by Curran (1934a) and Rettenmeyer (1961b). The morphological terminology used in the descriptions of the specimens follows Cumming and Wood (2017). Photographs of emerged flies were taken with a Leica MC170 HD digital camera attached to a Leica MZ16 stereomicroscope using the software Leica Application Suite version 4.12.0, stacked with Helicon Focus, and edited in Gimp 2.10. James O'Hara kindly provided pictures of *Anisia gilvipes* (Coquillett, 1897) and *Exoristoides johnsoni* Coquillett, 1897, deposited in the Canadian National Collection of Insects, Arachnids and Nematodes (CNC) to illustrate the identification key.

The host catalog follows an adapted format presented by Guimarães (1977) and Arnaud (1978). Species are listed alphabetically according to their respective biogeographical regions with valid names accompanied by authorship. Species names of grylloid hosts are followed by author, year of publication, page number, locality, respective tachinid parasitoid, and notes on the record. When necessary, we included comments and emendations regarding taxonomic nomenclature and reliability of the record in square brackets. To update the catalog of grylloid hosts, only published articles were considered, not including dissertations and theses. We also did not consider the use of sound traps broadcasting cricket calling songs to attract phonotactic orienting parasitoids as a host record. Moreover, as there are many studies on the host-parasitoid interactions of *O. ochracea* and to not unnecessarily inflate the catalog, we included only the first records in different localities to cover the distribution of host records. The original literature was checked to ensure the accuracy of the dates, titles, pagination, names, and localities. The classification of Tachinidae follows O'Hara et al. (2020), and the classification of Grylloidea follows the Orthoptera Species File (Cigliano et al. 2023).

Results

New host records

Record of *Anisia* Wulp, 1890, in *Aracamby* de Mello, 1992

In July 1990, one female of *Anisia* (Fig. 1A–C) was reared from an adult of *Aracamby* (Fig. 1D–G) collected from Caraguatatuba, São Paulo, Brazil. Only one *Anisia* species has been recorded in Brazil: *A. facialis* (Townsend, 1927), described from Itaquaquecetuba, São Paulo (Townsend 1927), and reared from Forficulidae (Dermaptera) (Parker 1953). Our specimen, however, differs from it by having the upper half of the fronto-orbital plate, scutum, and scutellum covered with slight golden pruinosity and wings hyaline.

The cricket specimen belongs to an undescribed species of *Aracamby* geographically close to *A. picinguabensis* de Mello, 1992; however, the tympana are absent on the foretibia, and the genital structures are somewhat different, mainly in the pseudepiphallic sclerite.

Record of *Calodexia* Wulp, 1891, and *Ormia ochracea* (Bigot, 1889) in *Anurogryllus* (*Urogryllus*) *toledopizai* (de Mello, 1988)

On November 21, 2012, one male of *Calodexia* (Fig. 2A–C) was reared from a male of *A.* (*U.*) *toledopizai* (Fig. 2J–M) collected from Canguçu, Rio Grande do Sul, Brazil. On December 30, 2013, a male and a female of *O. ochracea* (Fig. 2D–I) were reared from two males of *A.* (*U.*) *toledopizai* collected in São Lourenço do Sul, Rio Grande do Sul, Brazil. The male of *Calodexia* does not run to any species included in the identification keys of Curran (1934a) and Rettenmeyer (1961b). The head and thorax are covered with silver pruinosity; scutum with well-defined and separated vitta, legs yellow, and abdomen yellow on sides with a large brown vitta widening toward the tip and covering almost the entire dorsal surface of tergite 4. *Ormia ochracea* can be identified by having ocelli absent, parafacial bare, and tegula black; females with fronto-orbital plate swollen and frontal profile strongly arcuate; males with only one callosity on costal vein between veins R_1 and R_{2+3}; and male syncercus with apex straight in lateral view (Sabrosky 1953, Tavares 1965).

Details regarding the taxonomy and distribution of *A.* (*U.*) *toledopizai* can be found in Redü and Zefa (2017).

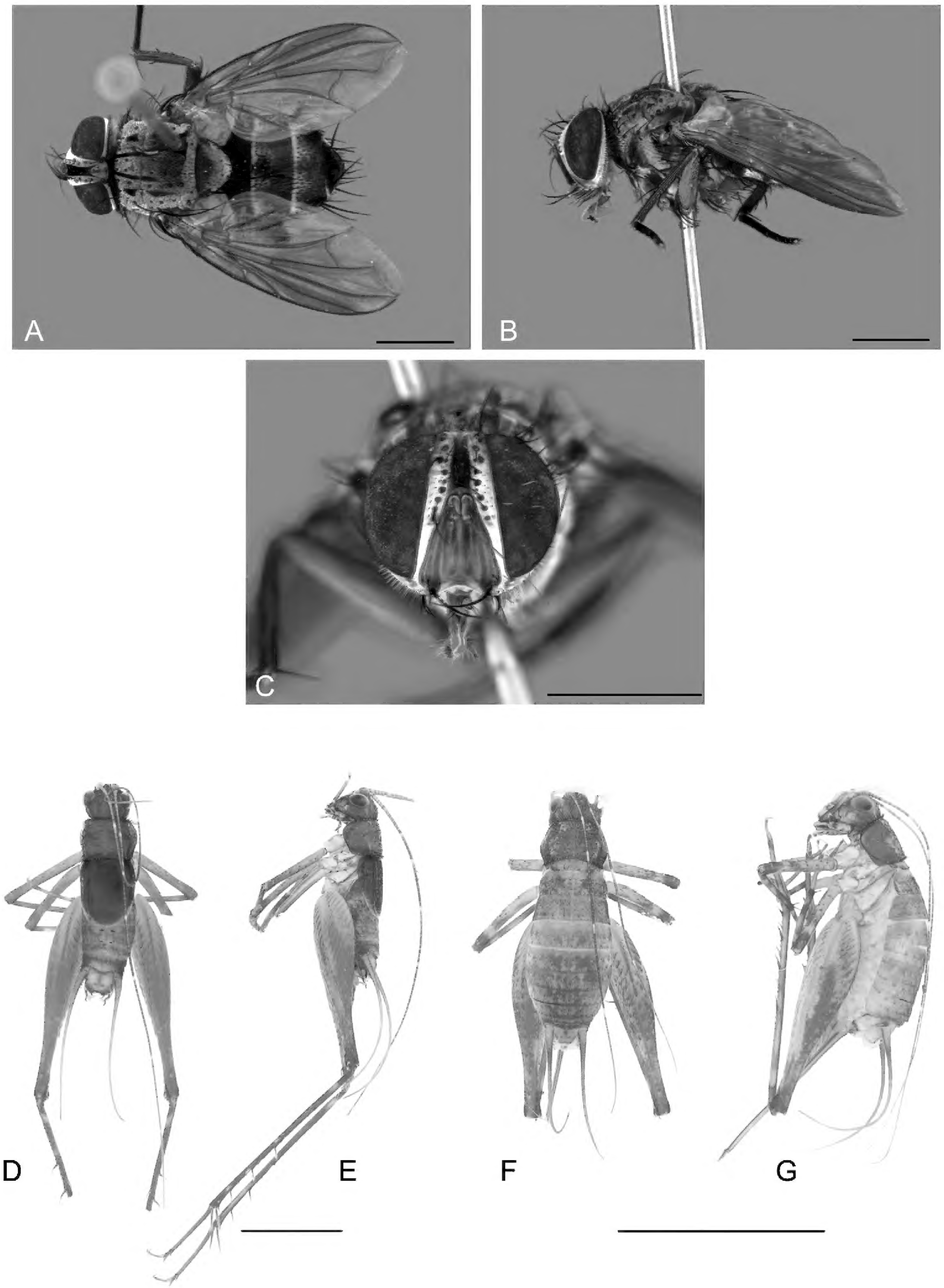

Fig. 1. *Anisia* Wulp, 1890, reared from *Aracamby* de Mello, 1992 (Phalangopsidae). **A–C.** *Anisia* female, dorsal habitus, lateral habitus, and head in frontal view, respectively; **D, E.** *Aracamby* male, dorsal and lateral habitus, respectively; **F, G.** *Aracamby* female, dorsal and lateral habitus, respectively. Scale bars: 2 mm (**A–C**); 5 mm (**D–G**).

Record of *Calodexia* cf. *fasciata* Curran, 1934a, in *Eidmanacris* Chopard, 1956

In August 1991, one female of *C.* cf. *fasciata* (Fig. 3A–C) was reared from an adult of *Eidmanacris* (Fig. 3D–G) collected from Apiaí, São Paulo, Brazil. *Calodexia fasciata* was described from Barro Colorado Island, Panama, based on a series of females (Curran 1934a). Our specimen runs to *C. fasciata* in the identification keys of Curran (1934a) and Rettenmeyer (1961b) and fits the characters of the type series, such as the head, thorax, and abdomen covered with silver pruinosity but with an ochraceous tinge on fronto-orbital plate, scutum, and dorsal surface of abdomen; scutum with inner postsutural vittae fused; acrostichal setae 1:1; lateral surface of thorax with sparse black setulae and legs black. This species also does not have setae on the ventral surface of the mid tibia, which was not possible to verify in our specimen as almost all the legs were lost.

The specimen of *Eidmanacris* from Apiaí belongs to an undescribed species. Its morphological traits, such as the large dorsal band of the abdomen, supra anal plate latero-posterior projections, forewings with apex rounded, and metanotum covered by bristles, allow us to place this species within *Eidmanacris* Clade A (Campos et al. 2021). In contrast to other *Eidmanacris* species found inside holes and caves, the species from Clade A are found in litter and are present only in the Atlantic Forest.

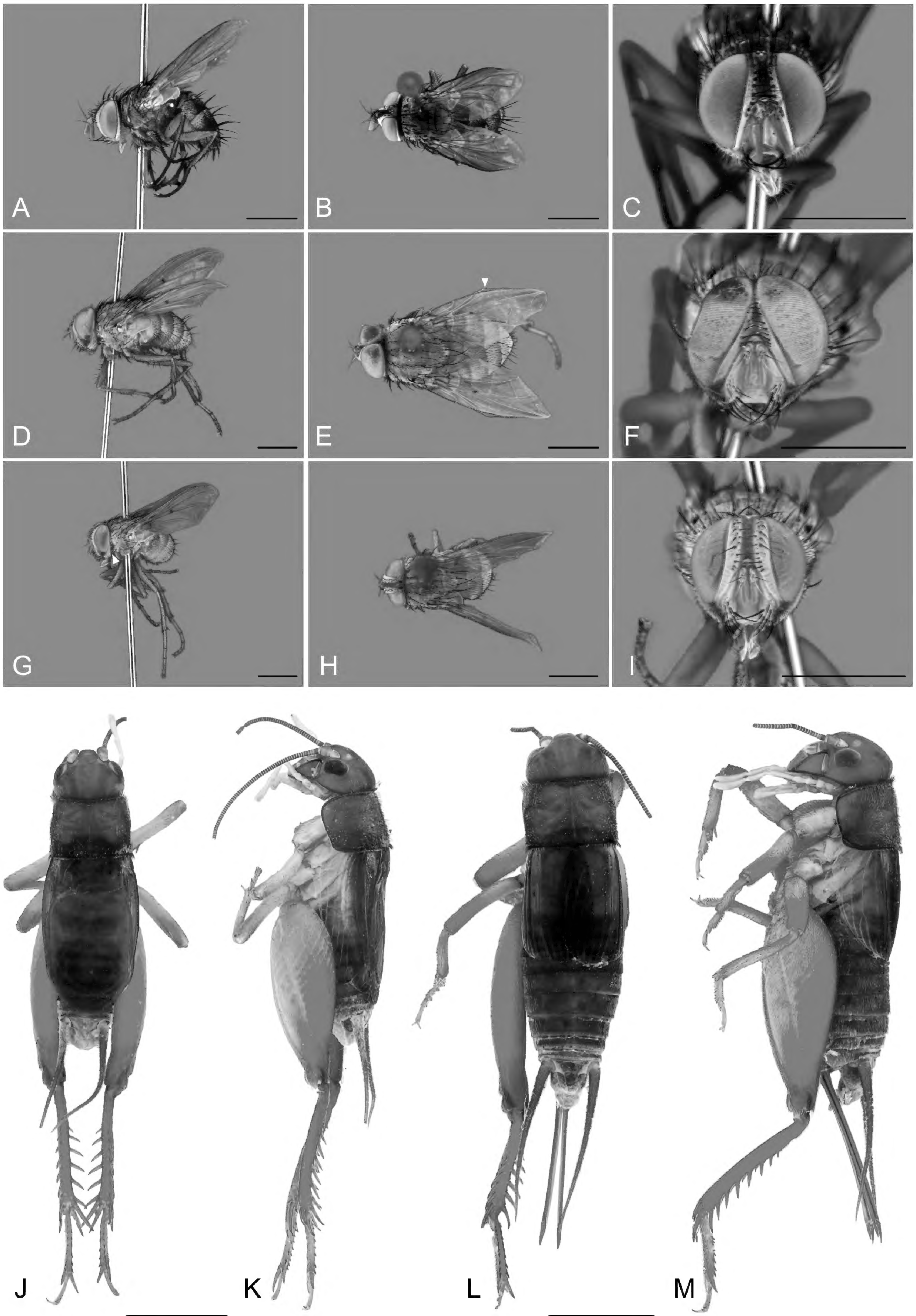

Fig. 2. *Calodexia* Wulp, 1891, and *Ormia ochracea* (Bigot, 1889), reared from *Anurogryllus* (*Urogryllus*) *toledopizai* (de Mello, 1988) (Gryllidae). **A–C.** *Calodexia* male, lateral habitus, dorsal habitus, and head in frontal view, respectively; **D–F.** *Ormia ochracea* male, lateral habitus, dorsal habitus, and head in frontal view, respectively, with white arrow showing callosity on costal vein; **G–I.** *Ormia ochracea* female, lateral habitus, dorsal habitus, and head in frontal view, respectively, with white arrow showing the position of the inflated basisternum and tympanal membrane; **J, K.** *Anurogryllus* (*U.*) *toledopizai* male, dorsal and lateral habitus, respectively; **L, M.** *Anurogryllus* (*U.*) *toledopizai* female, dorsal and lateral habitus, respectively. Scale bars: 2 mm (**A–I**); 5 mm (**J–M**).

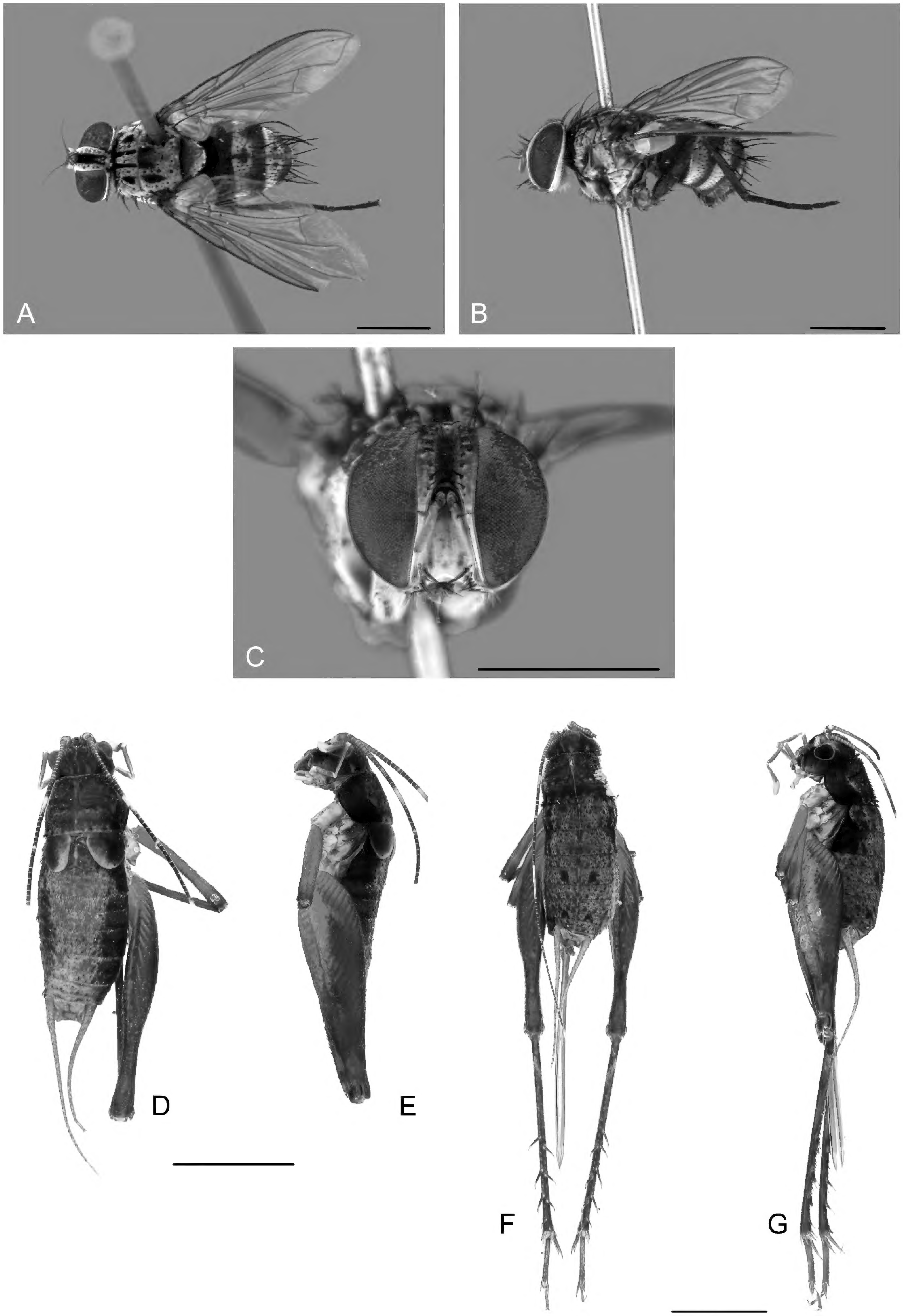

Fig. 3. *Calodexia* cf. *fasciata* Curran, 1934a, reared from *Eidmanacris* Chopard, 1956 (Phalangopsidae). **A–C.** *Calodexia* cf. *fasciata* female, dorsal habitus, lateral habitus, and head in frontal view, respectively; **D, E.** *Eidmanacris* male, dorsal and lateral habitus, respectively; **F, G.** *Eidmanacris* female, dorsal and lateral habitus, respectively. Scale bars: 2 mm (**A–C**); 5 mm (**D–G**).

Record of *Calodexia* cf. *flavipes* (Schiner, 1868) in *Aracamby* de Mello, 1992

In December 1990, two males of *Calodexia* cf. *flavipes* (Fig. 4A–C) were reared from adults of *Aracamby* (Fig. 4D–G) collected from Matinhos, Paraná, Brazil. *Calodexia flavipes* was described from Brazil based on a single male (Schiner 1868). Our specimens run to *C. flavipes* in the identification keys of Curran (1934a) and Rettenmeyer (1961b) and fit the characters of the holotype of *C. flavipes* as described by Aldrich (1929), such as the head, scutum, and abdomen covered with golden pruinosity; scutum with inner postsutural vittae fused; legs black with femora yellow at basal half; and abdomen slender and yellow with dark brown vitta. However, our specimens do not have yellow setulae on the ventral surface of the mid- and hind femora.

Similar to the previous record, these crickets belong to an undescribed *Aracamby* species. The main characters that set them apart from the species already described are mainly in the male genitalia and female copulatory papilla.

Record of *Calodexia* cf. *flavipes* (Schiner, 1868) in Phalangopsidae

On June 29, 1989, three males of *C.* cf. *flavipes* (Fig. 5A–C) were reared from adults of unidentified Phalangopsidae collected from Boracéia Biological Station, Salesópolis, São Paulo, Brazil. Our specimens fit the same characters as those presented in the record described above.

It was possible to identify the crickets only at the family level because of their poor condition.

Record of *Calodexia* cf. *insolita* Curran, 1934b, in *Pizacris* Souza-Dias & Desutter-Grandcolas, 2015

In July 1989, two females of *C.* cf. *insolita* (Fig. 6A–C) were reared from adults of *Pizacris* (Fig. 6E–G) collected from São Fidélis, Rio de Janeiro, Brazil. *Calodexia insolita* was described from Kartabo, Guyana, based on a single female (Curran 1934b). Our specimens run to *C. insolita* in the identification keys of Curran (1934b) and Rettenmeyer (1961b) and fit the characters of the holotype female, such as the head, thorax, and abdomen covered with silver pruinosity, but with an ochraceous tinge on fronto-orbital plate and scutum; ocellar setae absent; scutum with inner postsutural vittae fused and with postsutural pruinose vitta narrow; and legs black with femora yellow at basal half. We also found three females of *Stylogaster* Macquart, 1835 (Diptera: Conopidae), reared from *Pizacris* in the same locality (Fig. 6D).

The locality of the parasitized cricket is close to the type locality of *Pizacris carioca* Souza-Dias & Desutter-Grandcolas, 2015, in Rio de Janeiro. However, because of its poor condition, it was not possible to determine whether it is the same or an undescribed species.

Record of *Calodexia* cf. *venteris* Curran, 1934a, in *Guabamima lordelloi*, de Mello, 1993

In July 1989, one male of *C.* cf. *venteris* (Fig. 7A–C) was reared from a male of *G. lordelloi* (Fig. 7D–G) collected from Fazenda Farol, Mucuri, Bahia, Brazil. *Calodexia venteris* was described from Barro Colorado, Panama, based on a series of females (Curran 1934a). Our specimen runs to *C. venteris* in the identification keys of Curran (1934a) and Rettenmeyer (1961b) and fits the characters of the type series and the males described by Rettenmeyer (1961b), such as the head, scutum, and abdomen covered with golden pruinosity; ocellar setae weak; scutum with inner postsutural vittae fused; lateral surface of thorax with sparse white setulae; and abdomen slender and yellow with pruinose bands on basal half of tergites, without dark brown vitta. This species also has important characters in the legs, but it was not possible to verify this in our specimen as all legs were lost.

Of the parasitized crickets recorded in this study, the specimen of *G. lordelloi* was the only one in good enough condition to be photographed. Moreover, it is the holotype of this species (de Mello 1993) (Fig. 7D, E), which is deposited in the MZSP.

Identification key to Tachinidae genera recorded in Grylloidea

To date, species from four Tachinidae genera have been recorded with certainty as parasitoids of true crickets (see catalog below): *Anisia* and *Calodexia* (Exoristinae: Blondeliini), *Exoristoides* (Tachininae: Polideini), and *Ormia* (Tachininae: Ormiini). *Anisia* and *Ormia* include 21 and 27 valid species, respectively, distributed throughout the Nearctic and Neotropical regions; *Calodexia* includes 40 valid species and is endemic to the Neotropical region; and *Exoristoides* includes five valid species that occur in the Nearctic region and Central America (Wood and Zumbado 2010, O'Hara et al. 2020). These genera can be identified by the following character sets, adapted from the identification key of Wood and Zumbado (2010):

1 Body color light yellow; thorax with basisternum inflated (also called prosternum by several authors; more details in Gudin and Nihei (2019)) and associated with a pair of tympanal membranes facing the back of the head (Fig. 2G, white arrow); wings of male usually with callosities on costal vein and occasionally on vein R_{2+3} (Fig. 2E, white arrow); abdomen globose................ ***Ormia* Robineau-Desvoidy, 1830**

– Body color brown, dark brown, or gray; thorax with basisternum shaped as a regular sclerite and without tympanal membranes; wings of male without callosities on veins; abdomen usually longer than wide (except in females of *Calodexia*, with abdomen globose; see 3)............**2**

2 Eye densely haired (Fig. 8B, D); metathoracic spiracle with anterior and posterior lappets well-developed and forming a V-shaped opening (Fig. 8C); wing with bend of vein M forming angle of 90° or less (Fig. 8A) ....***Exoristoides* Coquillett, 1897**

– Eye bare; metathoracic spiracle with posterior lappet well-developed and shaped as an operculum; wing with bend of vein M obtuse (Fig. 8E, G)... **3**

3 Eye very large, covering most of side of head (Fig. 4B); gena reduced to a narrow strip with distance between eye and genal margin less than twice width of palpus; male with head without proclinate orbital setae and with abdomen long, subtriangular (Fig. 4A, B); female with abdomen globose and tubular ovipositor projected ventrally (Fig. 6B) ....***Calodexia* Wulp, 1891**

– Eye large but with gena well-developed (Figs 1B, 8E, G), with distance between eye and genal margin greater than twice width of palpus; male with head bearing two pairs of proclinate orbital setae and with abdomen ovoid (Fig. 8E, F); female with abdomen ovoid and ovipositor directed terminally, not projected (Figs 1A, 8G) ....***Anisia* Wulp, 1890**

Annotated catalog of grylloid hosts of Tachinidae

At least ten species of Tachinidae in four genera of the New World are currently recorded as parasitoids of at least 31 species of the families Gryllidae, Oecanthidae, and Phalangopsidae

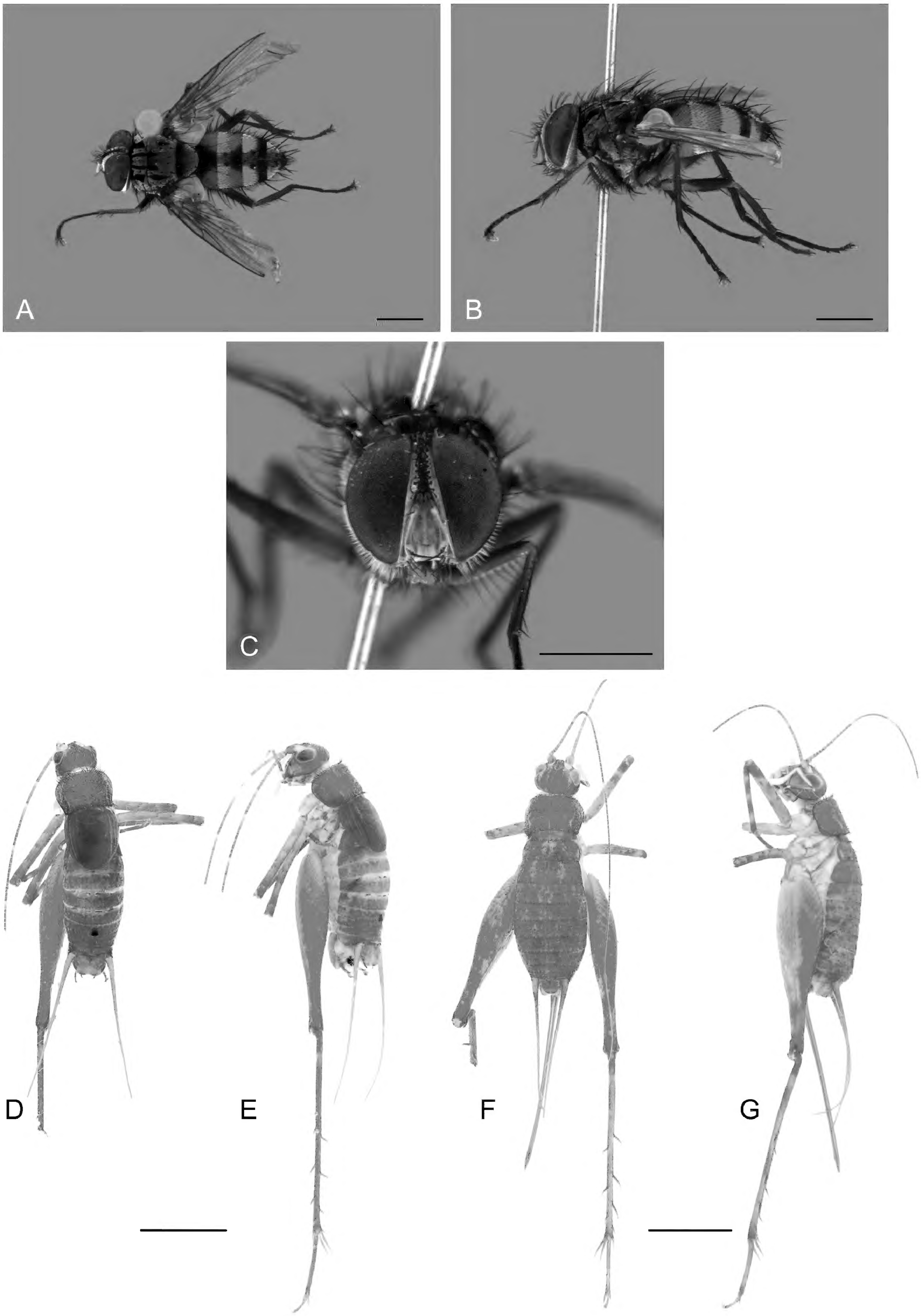

Fig. 4. *Calodexia* cf. *flavipes* (Schiner, 1868) reared from *Aracamby* de Mello, 1992 (Phalangopsidae). **A–C.** *Calodexia* cf. *flavipes* male, dorsal habitus, lateral habitus, and head in frontal view, respectively; **D, E.** *Aracamby* male, dorsal and lateral habitus, respectively; **F, G.** *Aracamby* female, dorsal and lateral habitus, respectively. Scale bars: 2 mm (**A–C**); 5 mm (**D–G**).

(Table 1). To the best of our knowledge, there are currently no published records of tachinid parasitism in true crickets in biogeographical regions other than the Nearctic and Neotropical regions. The parasitism records of *O. ochracea* in *Teleogryllus* (*Teleogryllus*) *oceanicus* (Le Guillou, 1841) in Hawaii actually involve two exotic species: *O. ochracea* was introduced in Hawaii probably from western North American populations of the United States of America, and *T.* (*T*) *oceanicus* was introduced from Australia (Gray et al. 2019). Parasitism records obtained through artificial infestation in the laboratory are indicated in the catalog.

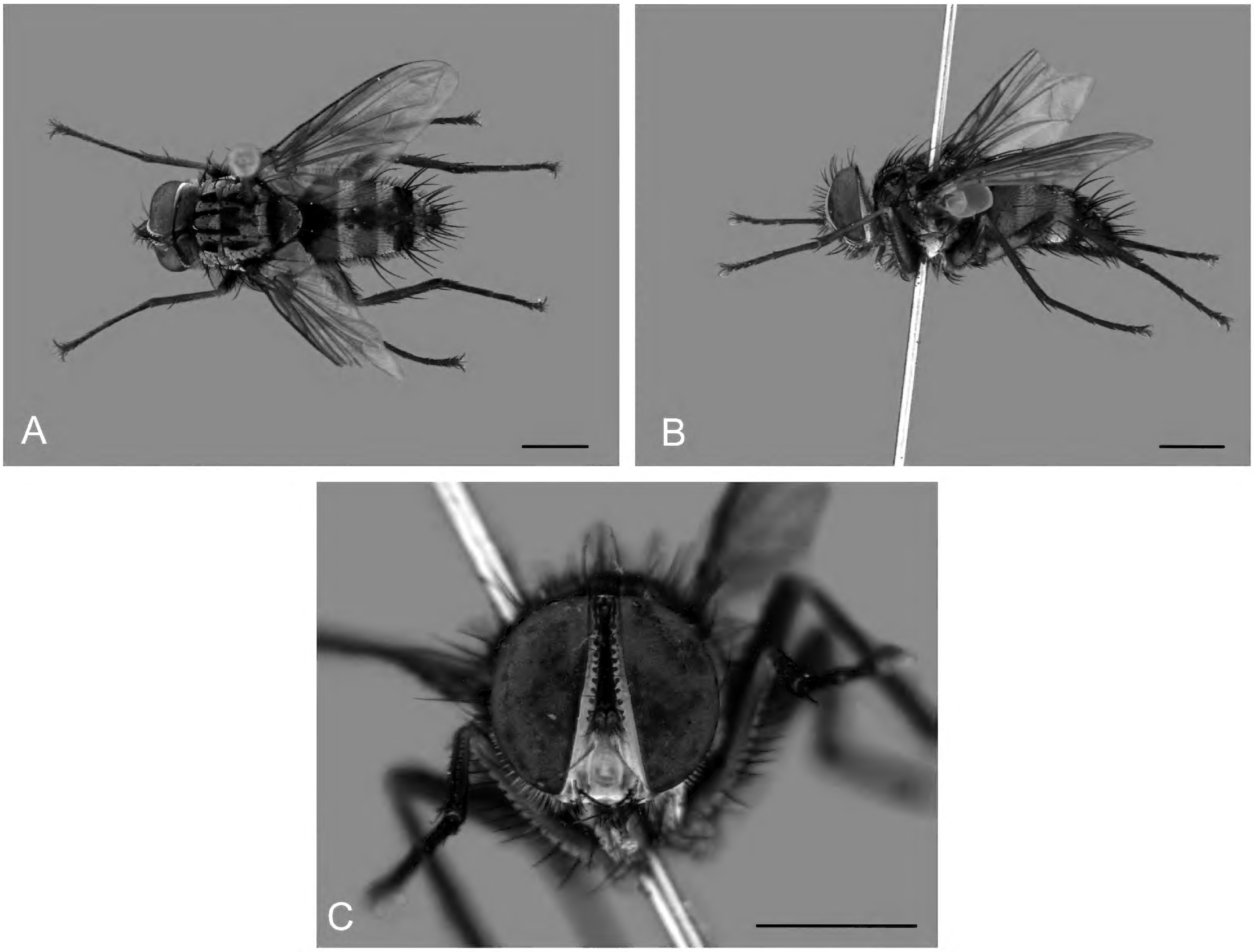

Fig. 5. *Calodexia* cf. *flavipes* (Schiner, 1868) reared from an unidentified Phalangopsidae. **A–C.** *Calodexia* cf. *flavipes* male, dorsal habitus, lateral habitus, and head in frontal view, respectively. Scale bars: 2 mm (**A–C**); 5 mm (**D–G**).

Australasian Region

Teleogryllus (*Teleogryllus*) *oceanicus* (Le Guillou, 1841)
(Gryllidae, Gryllinae, Gryllini) [introduced species]

Zuk et al. (1993: 340, record from Hilo, Hawaii County, Hawaii, United States of America, parasitoid as *Ormia ochracea* (Bigot) [introduced species]); Zuk et al. (1998: 167, records from Hilo (Hawaii County), Manoa (Honolulu County) and Research Station (Kauai County), Hawaii, United States of America, parasitoid as *O. ochracea* [introduced species]).

Nearctic Region

Acheta domesticus (Linnaeus, 1758)
(Gryllidae, Gryllinae, Gryllini)

Wineriter and Walker (1990: 625, record [artificial infestation] from Gainesville, Alachua County, Florida, United States of America, parasitoid as *Ormia ochracea* (Bigot)); Adamo (1998: 530, record [artificial infestation] from Halifax, Nova Scotia, Canada, parasitoid as *O. ochracea*); Paur and Gray (2011: 148, record [artificial infestation] from Northridge, Los Angeles, Los Angeles County, California, United States of America, parasitoid as *O. ochracea*).

Anurogryllus (*Anurogryllus*) *arboreus* Walker, 1973
(Gryllidae, Gryllinae, Gryllini)

O'Hara (2002: 159, record from Gainesville, Alachua County, Florida, United States of America, parasitoid as *Exoristoides johnsoni* Coquillett).

Anurogryllus (*Anurogryllus*) *muticus* (de Geer, 1773)
(Gryllidae, Gryllinae, Gryllini)

Weaver and Sommers (1969: 342, record from Louisiana, United States of America, parasitoids as unidentified *Exoristoides* Coquillett and Theresiini [=Dexiini. Species of Dexiini are generally parasitoids of coleopteran and lepidopteran larvae (Guimarães 1977, Arnaud 1978). Dexiini females are ovoviviparous, laying incubated membranous eggs with well-developed first instar larvae that actively search for the host. Although this record may be reliable, the parasitism of a Dexiini specimen on a grylloid host is probably accidental, as Dexiini larvae are commonly deposited in litter]).

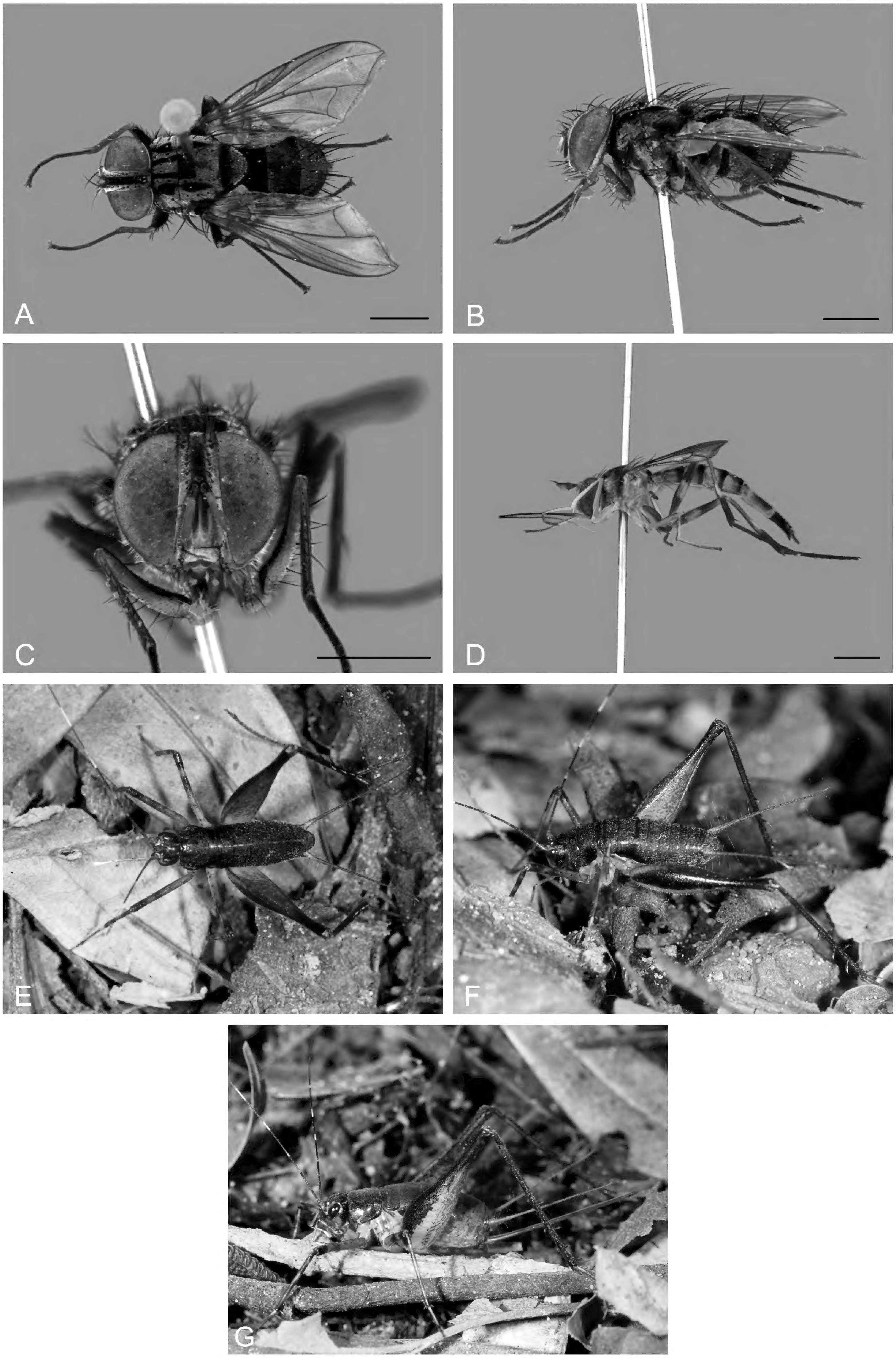

Fig. 6. *Calodexia* cf. *insolita* Curran, 1934b (Tachinidae), and *Stylogaster* Macquart, 1835 (Conopidae), reared from *Pizacris* Souza-Dias and Desutter-Grandcolas, 2015 (Phalangopsidae). **A–C.** *Calodexia* cf. *insolita* female, dorsal habitus, lateral habitus, and head in frontal view, respectively; **D.** *Stylogaster* female, lateral habitus; **E, F.** *Pizacris* male, dorsal and lateral habitus, respectively; **G.** *Pizacris* female, lateral habitus. Scale bars: 2 mm (**A–D**); 5 mm (**E–G**).

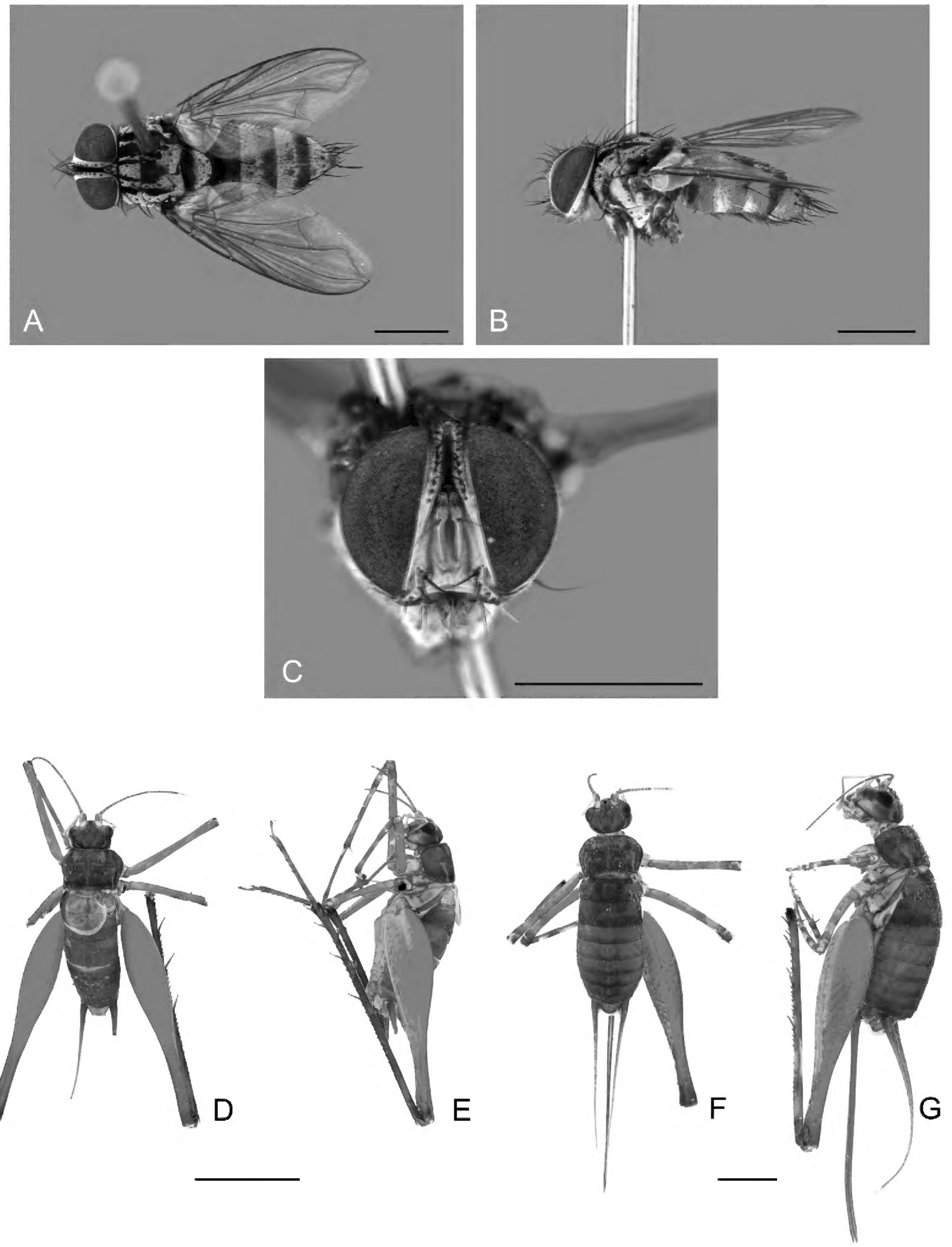

Fig. 7. *Calodexia* cf. *venteris* Curran, 1934a, reared from *Guabamima lordelloi* de Mello, 1993 (Phalangopsidae). **A–C.** *Calodexia* cf. *venteris* male, dorsal habitus, lateral habitus, and head in frontal view, respectively; **D, E.** *Guabamima lordelloi* holotype male, dorsal and lateral habitus, respectively; **F, G.** *Guabamima lordelloi* female, dorsal and lateral habitus, respectively. Scale bars: 2 mm (**A–C**); 5 mm (**D–G**).

Gryllus (*Gryllus*) *armatus* Scudder, 1902
(Gryllidae, Gryllinae, Gryllini)

Weissman and Gray (2019: 119, records from Havasu Lake (San Bernardino County, California), and Wenden (La Paz County, Arizona), United States of America, parasitoid as *Ormia ochracea* (Bigot)).

Gryllus (*Gryllus*) *assimilis* (Fabricius, 1775)
(Gryllidae, Gryllinae, Gryllini)

Reinhard (1922: 72, record from College Texas, Brazos County, United States of America, parasitoid as *Ormia ochracea* (Bigot)); Severin (1926: 224, record from South Dakota, United States of America, parasitoid as *Exoristoides johnsoni* Coquillett); Aldrich (1932: 24, records from Sacramento (Sacramento County), and Winters (Yolo County), California, United States of America, parasitoid as *E. johnsoni*); Thomson et al. (2012: 44, record [artificial infestation] from Bastrop County, Texas, United States of America, parasitoid as *O. ochracea*).

Gryllus (*Gryllus*) *bimaculatus* de Geer, 1773
(Gryllidae, Gryllinae, Gryllini)

Adamo et al. (1995: 270, record [artificial infestation] from Ithaca, Tompkins County, New York, United States of America, parasitoid as *Ormia ochracea* (Bigot)).

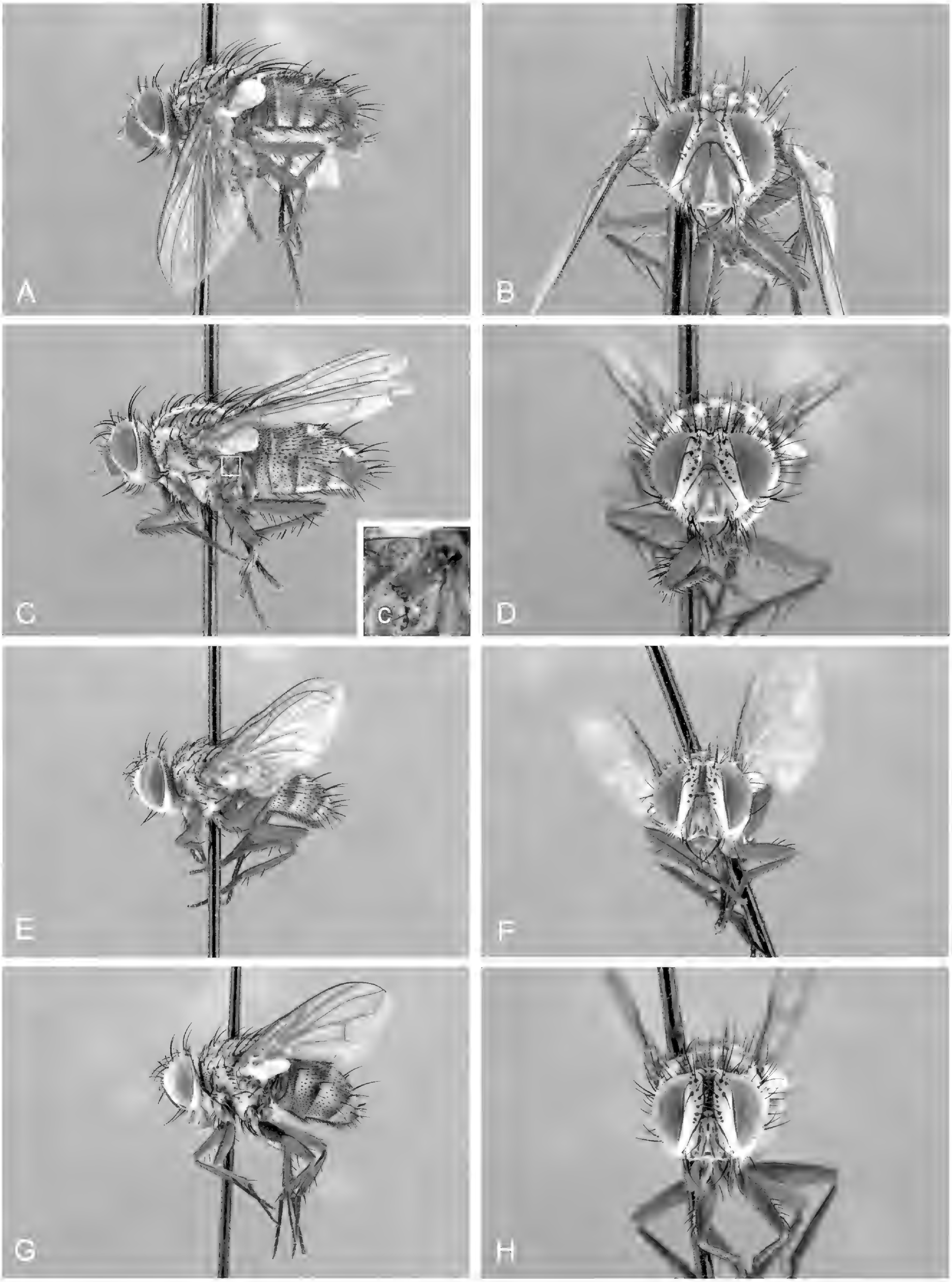

Fig. 8. *Exoristoides johnsoni* Coquillett, 1897 (Polideini), and *Anisia gilvipes* (Coquillett, 1897) (Blondeliini), deposited in CNC. **A, B.** *Exoristoides johnsoni* male, lateral and dorsal habitus, respectively; **C, D.** *Exoristoides johnsoni* female, lateral and dorsal habitus, respectively, with detail (c) of metathoracic spiracle; **E, F.** *Anisia gilvipes* male, lateral and dorsal habitus, respectively; **G, H.** *Anisia gilvipes* female, lateral and dorsal habitus, respectively. Images originally lacking scales.

Table 1. List of tachinids that are parasitoids of Grylloidea and their respective hosts according to biogeographical regions. Details about the records, localities, and respective references can be found in the host catalog in the main text. New hosts recorded in this study are marked with an asterisk.

Tachinidae species	Grylloidea hosts
Australasian Region	
Ormia ochracea	*Teleogryllus* (*Teleogryllus*) *oceanicus*
Nearctic Region	
Anisia gilvipes	Unidentified Grylloidea
Anisia sp.	*Gryllus* sp.
Exoristoides johnsoni	*Anurogryllus* (*Anurogryllus*) *arboreus*
	Anurogryllus (*Anurogryllus*) *muticus*
	Gryllus (*Gryllus*) *assimilis*
	Gryllus (*Gryllus*) *integer*
	Gryllus (*Gryllus*) *montis*
	Gryllus (*Gryllus*) *pennsylvanicus*
	Gryllus (*Gryllus*) *saxatilis*
	Gryllus (*Gryllus*) *veletis*
	Gryllus (*Gryllus*) *vocalis*
Ormia dominicana	*Hapithus* (*Orocharis*) *luteolira*
Ormia ochracea	*Acheta domesticus*
	Gryllus (*Gryllus*) *armatus*
	Gryllus (*Gryllus*) *assimilis*
	Gryllus (*Gryllus*) *bimaculatus*
	Gryllus (*Gryllus*) *cohni*
	Gryllus (*Gryllus*) *firmus*
	Gryllus (*Gryllus*) *integer*
	Gryllus (*Gryllus*) *lightfooti*
	Gryllus (*Gryllus*) *lineaticeps*
	Gryllus (*Gryllus*) *longicercus*
	Gryllus (*Gryllus*) *montis*
	Gryllus (*Gryllus*) *multipulsator*
	Gryllus (*Gryllus*) *ovisopis*
	Gryllus (*Gryllus*) *rubens*
	Gryllus (*Gryllus*) *saxatilis*
	Gryllus (*Gryllus*) *staccato*
	Gryllus (*Gryllus*) *texensis*
	Gryllus (*Gryllus*) *vocalis*
Unidentified Dexiini	*Anurogryllus* (*Anurogryllus*) *muticus*
Unidentified Tachinidae	*Gryllus* (*Gryllus*) *brevicaudus*
Neotropical Region	
Anisia sp.	*Aracamby* sp.*
Calodexia cf. *flavipes*	*Aracamby* sp.*
	Unidentified Phalangopsidae*
Calodexia cf. *fasciata*	*Eidmanacris* sp.*
Calodexia cf. *insolita*	*Pizacris* sp.*
Calodexia interrupta	*Ponca venosa*
Calodexia cf. *venteris*	*Guabamima lordelloi**
Calodexia sp.	*Anurogryllus* (*Urogryllus*) *toledopizai**
	Eneoptera sp.
	Unidentified Grylloidea
	Unidentified Phalangopsidae
Ormia depleta	*Anurogryllus* sp.
Ormia ochracea	*Anurogryllus* (*Urogryllus*) *toledopizai**
	Gryllus (*Gryllus*) *assimilis*
	Gryllus (*Gryllus*) *cohni*
	Gryllus (*Gryllus*) *multipulsator*
	Gryllus (*Gryllus*) *staccato*
	Gryllus sp.

Gryllus (*Gryllus*) *brevicaudus* Weissman, Rentz & Alexander, 1980
(Gryllidae, Gryllinae, Gryllini)

Weissman and Gray (2019: 40, record from Stanford University's Jasper Ridge Biological Preserve, San Mateo County, California, United States of America, parasitoid as unidentified Tachinidae).

Gryllus (*Gryllus*) *cohni* Weissman, Rentz & Alexander, 1980
(Gryllidae, Gryllinae, Gryllini)

Weissman and Gray (2019: 168, record from Agua Fria, Yavapai County, Arizona, United States of America, parasitoid as *Ormia ochracea* (Bigot)).

Gryllus (*Gryllus*) *firmus* Scudder, 1902
(Gryllidae, Gryllinae, Gryllini)

Wineriter and Walker (1990: 625, record [artificial infestation] from Gainesville, Alachua County, Florida, United States of America, parasitoid as *Ormia ochracea* (Bigot)); Thomson et al. (2012: 44, record [artificial infestation] from Bastrop County, Texas, United States of America, as *Gryllus* #45 [species identified in Weissman and Gray (2019: 54)], parasitoid as *O. ochracea*); Weissman and Gray (2019: 61, record from Matagorda County, Texas, United States of America, parasitoid as *O. ochracea*).

Gryllus (*Gryllus*) *integer* Scudder, 1901
(Gryllidae, Gryllinae, Gryllini)

Cade (1975: 1312, record from Austin, Travis County, Texas, United States of America, parasitoid as *Euphasiopteryx ochracea* [=*Ormia ochracea* (Bigot)]); Cade (1984: 226, record [artificial infestation] from San Antonio, Bexar County, Texas, United States of America, parasitoid as *E. ochracea* [=*O. ochracea*]); Adamo (1998: 530, record [artificial infestation] from Halifax, Nova Scotia, Canada, parasitoid as *O. ochracea*); O'Hara and Gray (2004: 171, record from Holbrook, Navajo County, Arizona, United States of America [host species; however, may actually be *Gryllus* (*Gryllus*) *armatus* Scudder, see Weissman and Gray (2019: 110)], parasitoid as *Exoristoides johnsoni* Coquillett); Hedrick and Kortet (2006: 1113, records from Aguila (Maricopa County, Arizona), and Davis (Yolo County, California), United States of America, parasitoid as *O. ochracea*); Weissman and Gray (2019: 110, record from Fallon, Churchill County, Nevada, United States of America, parasitoid as *E. johnsoni*).

Gryllus (*Gryllus*) *lightfooti* Weissman & Gray, 2019
(Gryllidae, Gryllinae, Gryllini)

Weissman and Gray (2019: 213, records from Alamo Lake (La Paz County), Brown Canyon (Pima County), Mount Graham (Graham County), Painted Rock Petroglyph Site (Maricopa County), and Willcox Playa (Cochise County), Arizona, United States of America, parasitoid as *Ormia ochracea* (Bigot)).

Gryllus (*Gryllus*) *lineaticeps* Stål, 1861
(Gryllidae, Gryllinae, Gryllini)

Wagner (1996: 280, record from Tucker's Grove County Park, Santa Barbara, Santa Barbara County, California, United States of America, parasitoid as *Ormia ochracea* (Bigot)); Paur and Gray (2011: 147, record

from King Gillette Ranch near Malibu Creek State Park, Santa Monica Mountains, Los Angeles County, California, United States of America, parasitoid as *O. ochracea*); Beckers and Wagner (2012: 470, record from Rancho Sierra Vista, Santa Monica Mountais, Ventura County, California, United States of America, parasitoid as *O. ochracea*).

Gryllus (*Gryllus*) *longicercus* Weissman & Gray, 2019
(Gryllidae, Gryllinae, Gryllini)

Weissman and Gray (2019: 226 and 229, records from Kitt Peak (Pima County), and Palm Canyon, Kofa National Wildlife Refuge (Yuma and La Paz Counties), Arizona, parasitoid as *Ormia ochracea* (Bigot)).

Gryllus (*Gryllus*) *montis* Weissman & Gray, 2019
(Gryllidae, Gryllinae, Gryllini)

Weissman and Gray (2019: 204, records from Prescott National Forest (Yavapai County, Arizona) and Reserve (Catron County, New Mexico), United States of America, parasitoid as *Exoristoides johnsoni* Coquillett, and from Miller Canyon (Huachuca Mountains, Cochise County, Arizona), United States of America, parasitoid as *Ormia ochracea* (Bigot)).

Gryllus (*Gryllus*) *multipulsator* Weissman, 2009
(Gryllidae, Gryllinae, Gryllini)

Weissman and Gray (2019: 83, record from Yuma, Yuma County, Arizona, United States of America, parasitoid as *Ormia ochracea* (Bigot)).

Gryllus (*Gryllus*) *ovisopis* Walker, 1974
(Gryllidae, Gryllinae, Gryllini)

Wineriter and Walker (1990: 625, record [artificial infestation] from Gainesville, Alachua County, Florida, United States of America, parasitoid as *Ormia ochracea* (Bigot)).

Gryllus (*Gryllus*) *pennsylvanicus* Burmeister, 1838
(Gryllidae, Gryllinae, Gryllini)

Aldrich (1932: 24, record from Capa, Jones County, South Dakota, United States of America, as *G. abbreviatus* Serville, parasitoid as *Exoristoides johnsoni* Coquillett).

Gryllus (*Gryllus*) *rubens* Scudder, 1902
(Gryllidae, Gryllinae, Gryllini)

Wineriter and Walker (1990: 625, record from Gainesville, Alachua County, Florida, United States of America, parasitoid as *Ormia ochracea* (Bigot)).

Gryllus (*Gryllus*) *saxatilis* Weissman & Gray, 2019
(Gryllidae, Gryllinae, Gryllini)

Weissman and Gray (2019: 244, records from Fallon (Churchill County) and Winnemucca (Humboldt County), Nevada, United States of America, parasitoid as *Exoristoides johnsoni* Coquillett, and from Corn Springs and Palm Desert, Riverside County, California, United States of America, parasitoid as *Ormia ochracea* (Bigot).

Gryllus (*Gryllus*) *staccato* Weissman & Gray, 2019
(Gryllidae, Gryllinae, Gryllini)

Weissman and Gray (2019: 186, records from Agua Fria and Cordes Junction (Yavapai County), Catalina and Robles Junction (Pima County), and Wenden (La Paz County), Arizona, United States of America, parasitoid as *Ormia ochracea* (Bigot)).

Gryllus (*Gryllus*) *texensis* Cade & Otte, 2000
(Gryllidae, Gryllinae, Gryllini)

Vincent and Bertram (2009: 599, records from Austin and Smithville, Bastrop County, Texas, United States of America, parasitoid as *Ormia ochracea* (Bigot)); Weissman and Gray (2019: 96, records from Bentsen-Rio Grande Valley State Park (Hidalgo County), Brownsville (Cameron County), Del Rio (Val Verde County), and Schulenburg (Fayette County), Texas, United States of America, parasitoid as *O. ochracea*).

Gryllus (*Gryllus*) *veletis* (Alexander & Bigelow, 1960)
(Gryllidae, Gryllinae, Gryllini)

Weissman and Gray (2019: 145, records from Chadron (Dawes County, Nebraska), Road to Zion Narrows (Kane County, Utah), and Sioux Falls (Minnehaha County, South Dakota), United States of America, parasitoid as *Exoristoides johnsoni* Coquillett).

Gryllus (*Gryllus*) *vocalis* Scudder, 1901
(Gryllidae, Gryllinae, Gryllini)

Weissman and Gray (2019: 161, records from Fallon, Churchill County, Nevada, United States of America, parasitoid as *Exoristoides johnsoni* Coquillett, and from Agua Fria (Yavapai County, Arizona), Ballona Wetlands (Los Angeles County, California), Fallon (Churchill County, Nevada), and Sedona (Yavapai and Coconino Counties, Arizona), United States of America, parasitoid as *Ormia ochracea* (Bigot)).

Unidentified *Gryllus* Linnaeus, 1758
(Gryllidae, Gryllinae, Gryllini)

Woodley and Judd (1998: 659, record from Gainesville, Alachua County, Florida, United States of America, parasitoid as unidentified *Anisia* Wulp).

Hapithus (*Orocharis*) *luteolira* (Walker, 1969)
(Oecanthidae, Podoscirtinae, Hapithidi, Hapithini)

Walker et al. (1996: 381, record from Florida, United States of America, as *Orocharis luteolira*, parasitoid as *Ormia dominicana* Townsend, 1919).

Unidentified Grylloidea

Aldrich (1928: 301, record from Kansas, United States of America, as cricket, parasitoid as *Oedomatocera gilvipes* [=*Anisia gilvipes* (Coquillett)]).

Neotropical Region

Anurogryllus (*Urogryllus*) *toledopizai* (de Mello, 1988)
(Gryllidae, Gryllinae, Gryllini)

Gudin et al., present records from Canguçu, Rio Grande do Sul, Brazil, parasitoid as unidentified *Calodexia* Wulp, and São João da Reserva, São Lourenço do Sul, Rio Grande do Sul, Brazil, parasitoid as *Ormia ochracea* (Bigot).

Unidentified *Anurogryllus* Saussure, 1877
(Gryllidae, Gryllinae, Gryllini)

Fowler and Mesa (1987: 408, record from Ipeúna, São Paulo, Brazil, parasitoid as *Euphasiopteryx depleta* [=*Ormia depleta* (Wiedemann, 1830)]); Fowler (1988: 398, record [artificial infestation] from Rio Claro, São Paulo, Brazil, parasitoid as *E. depleta* [=*O. depleta*]).

Unidentified *Aracamby* de Mello, 1992
(Phalangopsidae, Luzarinae, Aracambiae)

Gudin et al., present records from Caraguatatuba, São Paulo, Brazil, parasitoid as unidentified *Anisia* Wulp, and from Matinhos, Paraná, Brazil, parasitoid as *Calodexia* cf. *flavipes* (Schiner).

Gryllus (*Gryllus*) *assimilis* (Fabricius, 1775)
(Gryllidae, Gryllinae, Gryllini)

Tavares (1965: 21, record from Ribeirão Preto, São Paulo, Brazil, parasitoid as *Euphasiopteryx ochracea* [=*Ormia ochracea* (Bigot)]).

Gryllus (*Gryllus*) *cohni* Weissman, Rentz & Alexander, 1980
(Gryllidae, Gryllinae, Gryllini)

Weissman and Gray (2019: 168, record from San Carlos Bay, Baja California Sur, Mexico, parasitoid as *Ormia ochracea* (Bigot)).

Gryllus (*Gryllus*) *multipulsator* Weissman, 2009
(Gryllidae, Gryllinae, Gryllini)

Weissman and Gray (2019: 168, record from San Carlos Bay, Baja California Sur, Mexico, parasitoid as *Ormia ochracea* (Bigot)).

Gryllus (*Gryllus*) *staccato* Weissman & Gray, 2019
(Gryllidae, Gryllinae, Gryllini)

Weissman and Gray (2019: 168, record from San Carlos Bay, Baja California Sur, Mexico, parasitoid as *Ormia ochracea* (Bigot)).

Unidentified *Gryllus* Linnaeus, 1758
(Gryllidae, Gryllinae, Gryllini)

Fowler and Mesa (1987: 408, record [artificial infestation] from Rio Claro, São Paulo, Brazil, parasitoid as *Euphasiopteryx ochracea* [=*Ormia ochracea* (Bigot)]).

Unidentified *Eidmanacris* Chopard, 1956
(Phalangopsidae, Luzarinae)

Gudin et al., present record from Apiaí, São Paulo, Brazil, parasitoid as *Calodexia* cf. *fasciata* Curran.

Unidentified *Eneoptera* Burmeister, 1838
(Gryllidae, Eneopterinae, Eneopterini)

Rettenmeyer (1961b: 1027, record from Canal Zone Biological Area, Barro Colorado Island, Panama, parasitoid as unidentified *Calodexia* Wulp, near *C. agilis* Curran, 1934a, or *C. interrupta* Curran, 1934a).

Guabamima lordelloi de Mello, 1993
(Phalangopsidae, Luzarinae)

Gudin et al., present record from Mucuri, Bahia, Brazil, parasitoid as *Calodexia* cf. *venteris* Curran.

Unidentified *Pizacris* Souza-Dias & Desutter-Grandcolas, 2015
(Phalangopsidae, Luzarinae)

Gudin et al., present record from São Fidélis, Rio de Janeiro, Brazil, parasitoid as *Calodexia* cf. *insolita* Curran.

Ponca venosa Hebard, 1928
(Gryllidae, Eneopterinae, Lebinthini)

Rettenmeyer (1961b: 1026, record from Canal Zone Biological Area, Barro Colorado Island, Panama, parasitoid as *Calodexia interrupta* Curran).

Unidentified Grylloidea

Rettenmeyer (1961a: 15, record from Canal Zone Biological Area, Barro Colorado Island, Panama, parasitoid as unidentified *Calodexia* Wulp).

Unidentified Phalangopsidae

Rettenmeyer et al. (2011: 286, record from Trinidad, Trinidad and Tobago, host as cricket [probably *Luzara* Walker, 1869], parasitoid as unidentified *Calodexia* Wulp); Gudin et al., present record from Salesópolis, São Paulo, Brazil, parasitoid as *C.* cf. *flavipes* Curran.

Discussion

Based on the host catalog, there are at least three types of oviposition strategies used by tachinids that are parasitoids of true crickets: indirect oviposition with ovoviviparous species that lay incubated membranous eggs with well-developed first-instar larvae on the host's path (e.g., *Exoristoides* and *Ormia*) (Lehmann 2003, O'Hara and Gray 2004), oviparous species that deposit incubated microtype eggs on the host's food that are subsequently ingested by the host (e.g., *Anisia*) (Wood and Zumbado 2010), and direct oviposition with oviparous species that lay incubated membranous eggs with well-developed first-instar larvae directly on the cuticle of the host (e.g., *Calodexia*) (Rettenmeyer et al. 2011). Each oviposition strategy enables exploitation of different groups of true crickets.

Ormiini flies, including *Ormia* species, are frequently reared from mole crickets (Gryllotalpidae) and katydids (Tettigoniidae), which sing at high frequencies (Lehmann 2003). Only three species of *Ormia* seem to have adapted to detect lower frequency calls of true crickets: *O. depleta*, *O. dominicana*, and *O. ochracea* (Table 1). Four cricket genera from Gryllidae and Oecanthidae are

parasitized by *Ormia* species: *Hapithus* Uhler, 1864, *Anurogryllus* Saussure, *Gryllus* Linnaeus, and *Teleogryllus* Chopard, 1961. All of them are recognized as good singers with sound records used for species descriptions and bioacoustic studies (e.g., Walker 1977, Riede 1998, Gwynne 2001, Otte and Pérez-Gelabert 2009, Redü and Zefa 2017). *Anurogryllus* species are known for their long and loud trills, whereas the other three genera usually have species with calls characterized by chirps. Regarding the distribution of the three *Ormia* species recorded above, Gray et al. (2019) estimated the origin of *O. ochracea* in southern Mexico and/or the Gulf region of the United States of America (USA), with widespread distribution to the western USA and posterior introduction to Hawaii. Tavares (1965) extended its distribution southward, providing the first record of its occurrence in Brazil. *Ormia depleta* is a Neotropical species distributed in Brazil and Peru, with one record in Honduras in Central America (Sabrosky 1953, Tavares 1953), and *O. dominicana* is widely distributed in Central America and the southern United States (Sabrosky 1953).

In the genus *Exoristoides*, only *E. johnsoni* (Fig. 8A–D) has been reared from true crickets, but other species parasitize cockroaches (O'Hara 2002). *Exoristoides johnsoni* is widely distributed in the United States and southern Canada, with some records in Mexico (O'Hara 2002). Although *E. johnsoni* has a host range similar to that of *O. ochracea* (Table 1), these flies do not have morphological modifications to locate their hosts by sound. *Exoristoides* species have the same type of eggs and first-instar larvae as Ormiini and other tribes of the subfamily Tachininae (O'Hara and Gray 2004, Stireman et al. 2019), but their behavior is still unknown. Despite this, the behavior of species with similar oviposition strategies that parasitize orthopteroids has already been verified, such as *Triarthria setipennis* (Fallén, 1810), which is a parasitoid of earwigs (Dermaptera: Forficulidae) (Kuhlmann 1995, Tschorsnig 2017). Kuhlmann (1995) demonstrated that cardboard disks filled with earwig's scent and feces induce the oviposition of gravid females of *T. setipennis*, which suggests the existence of chemical substances involved in the search for the host. It is possible that a similar process may be observed in *Exoristoides* females, but further studies are necessary to clarify this.

Among these four genera, *Anisia* is the most difficult group to investigate because its taxonomy remains obscure and requires revision (Wood 1985). From the Nearctic region, only *A. gilvipes* (Fig. 8E–H) was reared from a true cricket and identified to species level (Aldrich 1928). *Anisia* species have also been reared from cockroaches, earwigs, grasshoppers (Acrididae), and camel crickets (Rhaphidophoridae) (Gemeno et al. 2002). Wood and Zumbado (2010) recorded the behavior of the Nearctic species *A. flaveola* (Coquillett, 1897), which deposits minute, unpigmented, and incubated eggs on the host's food. Similar eggs were also recorded in *A. facialis* (Townsend) by Parker (1953) and in *A. aberrans* (Townsend, 1935) and *A. fumipennis* (Thompson, 1968) by Thompson (1968). *Anisia* species have been recorded in *Gryllus* and *Aracamby* (Table 1), suggesting that singing is not necessarily the main cue used by gravid females to find their hosts. However, even though *Aracamby* males cannot produce calling songs as they lack important traits of the stridulatory apparatus on the forewings, such as the mirror and harp (de Mello 1992), they are capable of performing low-frequency courtship songs (de Mello 2007). This raises the question of whether *Anisia* females are able to detect low-frequency sounds produced by their orthopteroid hosts. On the other hand, the use of chemical cues by *Anisia* females is also possible. As orthopteroids are normally generalists, the main cues used by *Anisia* females probably do not derive from the host's diet but from the host itself. Similar to what was hypothesized for *Exoristoides*, it is possible that *Anisia* females use chemical cues derived from their hosts, as the presence of chemical communication between crickets is known (e.g., Bell 1980, Thomas and Simmons 2008, Stamps and Shaw 2019). *Anisia* is the only blondeliine genus known to date that has this oviposition strategy. Microtype eggs also occur in the dufouriine genus *Oestrophasia* Brauer & Bergenstamm, 1889, and most notably in the tribe Goniini (Marini and Campadelli 1994, de Santis and Nihei 2022), but the morphology of their eggs is completely different.

Calodexia is a diverse Neotropical genus associated with army ants whose females are frequently found perched on the foliage ahead of advancing ants, waiting for fleeing orthopteroids (Rettenmeyer et al. 2011). Due to the extreme sexual dimorphism found in the genus, the association of males and females is a difficult task. *Calodexia* species have been reared only from cockroaches and crickets (Rettenmeyer 1961b). Gravid females quickly dart toward the fleeing host, laying incubated membranous eggs with well-developed first-instar larvae directly on the cuticle of the host (Rettenmeyer et al. 2011). As *Calodexia* species are closely associated with army ants, females rely mainly on visual cues to search for hosts. This kind of search enables them to exploit several groups of true crickets, either chirping or silent species. For instance, males of *Aracamby*, *Eidmanacris*, and *Pizacris* have no forewings modified for stridulation (de Mello 1992, Campos et al. 2017, Souza-Dias et al. 2015); on the other hand, males of *Anurogryllus*, *Eneoptera* Burmeister, *Ponca* Hebard, 1928, and *Guabamima* de Mello, 1993, have forewings modified for sound production and propagation. These groups are usually found in litter, which exposes them to army ants and, consequently, to *Calodexia* females.

Conclusions

In this study, seven new host records in Gryllidae and Phalangopsidae species were recorded from Brazil for the first time. At least ten species of Tachinidae in the New World genera *Anisia*, *Calodexia*, *Exoristoides*, and *Ormia* are parasitoids of Gryllidae, Oecanthidae, and Phalangopsidae species. Only *Ormia* species use phonotactic cues to locate their singing hosts. *Anisia* and *Exoristoides* species may rely on chemical cues derived from the host, whereas *Calodexia* species locate their hosts visually. The host range of *Calodexia* species seems to be wider than that of species in the three other genera, as the association with army ants allows them to exploit the diversity of cricket species that live in litter. Further studies on the biology of *Anisia* and *Exoristoides* species are necessary to improve our knowledge of Tachinidae–Orthoptera interactions.

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